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The Impact of Changing Property Rights on Investment in Cloud Computing Ventures

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Our analysis seeks to understand the impact of changing allocations of property rights on investment in new firms. We focus on the Cartoon Network, et al. v. Cablevision decision in the U.S., which narrowed the protection enjoyed by content creators (e.g., movie studios) and gave greater rights to downstream technology firms, as well as decisions in France and Germany that took an opposite view. Our findings regarding relative venture capital investment in the U.S. and Europe, across Europe, and between the various judicial circuits of the U.S. suggest that decisions around the allocation of property rights can have economically and statistically significant impacts on investment in innovative enterprises.

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Funding for this research was provided by the Computers and Communication Industry Association, whose members can be found here, http://www.ccianet.org/index.asp?bid=11, Harvard Business School's Division of Research, and the Toulouse Network on Information Technology. We thank a number of venture capital investors, seminar audiences at the National Bureau of Economic Research, the Toulouse Network, and numerous universities, and Mark Lemley, Matt Marx, Rob Merges, Michael Meurer, and Scott Stern, for helpful comments. All errors and omissions are our own.

1. Introduction

The ways in which the strength and allocation of property rights can affect investment decisions have been an enduring topic of interest (e.g., La Porta et al. [2000], Acemoglu [2003]). The consequences of property rights are particularly critical when evaluating intellectual property policies. An extensive theoretical literature suggests that shifts in the design of such property right schemes—in particular, the relative protection offered to initial innovators and those who do follow-on work—can have dramatic impacts on the rate and direction of technological progress. For instance, if all the rewards go to the initial innovators, other firms are unlikely to be able to access resources for follow-on innovations (e.g., Gilbert and Shapiro [1990]; Scotchmer [2004]; Hopenhayn, et al. [2006]; and, Boldrin and Levine [2008]).

The empirical literature on the impact of changes in the nature of property rights on the ability to finance innovation, however, remains inconclusive (see, for instance, Sakakibara and Branstetter [2001]; Branstetter, et al. [2006]; and, Lerner [2009]). Many of the difficulties stem from the difficulties of identifying appropriate "natural experiments." Legislation altering intellectual property rights is often undertaken in conjunction with other policy reforms or in response to shifting economic circumstances. Moreover, empirical studies to date have largely focused on the patent regime: given the long lag times between discoveries and commercial application in many technical fields, identifying what effects may exist empirically can be especially challenging.

The shorter time lags between the production and dissemination of creative activities and software suggest that examining the impacts of copyright law may be more promising. From a more practical perspective, the consequences of shifting copyright protection remains intensely

partisan, given the intensity of real world controversies about the Digital Millennium Copyright Act and the proposed Stop Online Piracy Act.

This paper examines the effect of major but largely unanticipated changes in the allocation of copyright protection on venture capital (VC) investment in cloud computing companies. In particular, it examines the impact of the Second Circuit Court of Appeals' decision *The Cartoon Network, et al. v. Cablevision*, which was widely perceived as enhancing the property rights of cloud computing companies relative to the content owners such as major movie studios and publishers, a claim backed by an event study of cloud-computing firms. Meanwhile, decisions in French and German courts took substantially narrower views of these firms' property rights.

We focus on the impact of these decisions on VC investment because venture activity is well documented, and has been shown to have a positive impact on growth and innovation. Thus, while VC represents only a fraction of total investment in this industry, it is a natural setting for understanding the impact of policy shifts.

To understand the impact of copyright protection changes on the willingness of venture capitalists to invest in cloud computing, we employ a difference-in-difference approach, hypothesizing that policy shifts affect investments in different geographies, sectors, and years in varying ways. Such analyses have been widely employed in the economics literature to examine the consequences of policy shifts.

To quantify the impact of copyright protection changes, we first analyze the effects on VC investment in cloud computing firms of the *Cablevision* decision in the U.S., which narrowed the protection enjoyed by content creators (e.g., movie studios) and gave greater rights to downstream technology firms using this content. We anticipate that the decision eased investors' fears about litigation entangling innovative cloud computing firms, resulting in greater

investments. We find that VC investment in cloud computing firms increased significantly in the U.S. relative to the EU after the *Cablevision* decision, particularly in the geographies and sectors most affected by the decision. The *Cablevision* decision, along with court rulings in France and Germany, led to additional incremental investment in U.S. cloud computing firms that ranged from $728 million to approximately $1.3 billion over the two-and-a-half years after the decision.

We then examine court rulings in France and Germany, which were perceived as moving in the opposite direction. We look at VC investment in cloud computing firms in these countries relative to that in other EU nations. We find that these rulings regarding the nature of copyright protection had significant negative impacts on investment. Specifically, we find that VC investment in cloud computing firms declined in Germany and France, relative to the rest of the EU, after the French and German rulings.

Taken together, our findings suggest that shifts in the allocation of property rights can have significant impacts on investment in innovative enterprises. The findings suggest that strong upstream intellectual property rights, when combined with seeming large transaction costs that deterred licensing, may block investment in innovative downstream technologies. At the same time, we must acknowledge that this is a partial equilibrium analysis, which does not allow us to assess social welfare. For instance, these decisions may have had different effects on the willingness of incumbent firms to invest, as well as the impact on the development of new creative works.

The remainder of the paper is structured as follows. Section 2 justifies the use of venture financing as an indicator, and provides background on the *Cablevision* decision in the U.S. as well as on the French and German court rulings. Section 3 discusses the data used in our analyses, Section 4 presents our results from the analysis of the *Cablevision* decision, and

Section 5 presents our results from the analysis of the French and German rulings. Section 6 concludes the paper.

2. Background

2.1. Venture Financing as an Indicator

VC investment is an attractive measurement for several reasons.

The first rationale related to the practical nature of this measure for researchers. Venture financing is well documented, because of the presence of institutional investors who report the activities and performance of the funds in which they invest important due to data services such as those operated by Dow Jones and Thomson Reuters. Moreover, venture capitalists tend to fund young firms in well-defined areas, allowing a detailed mapping of funding by technological area. This specificity is in contrast to large corporations, who often report an aggregate R&D or those for broad lines of business.

Second, there is a well-documented relationship between venture capital funding, innovation and job growth. Hellmann and Puri [2000] examine a sample of 170 recently formed firms in Silicon Valley, including both venture-backed and non-venture-backed firms, and find that VC financing is related to more innovative product market strategies and a significant reduction in the time taken to bring a product to market. Kortum and Lerner [2000] examine the relationship between venture financing and innovation at an aggregate industry level. Exploiting the clarification the Employee Retirement Income Security Act, the U.S. Department of Labor in the late 1970s, a policy shift that freed pensions to invest in venture capital, they show that, even after addressing causality concerns, venture funding has a strong positive impact on innovation. Puri and Zarutskie [2010] compare the evolution of venture-backed and non-venture-backed

firms using the records of the U.S. Census's Longitudinal Business Database, and find very rapid employment growth in venture-financed firms relative to non-venture-financed firms.

2.2. The U.S. Litigation: *The Cartoon Network, et al. v. Cablevision*

Section 4 focuses on a key juncture in copyright policy in the United States: the 2008 appellate decision in *The Cartoon Network, et al. v. Cablevision*.[3] It will compare VC investment in cloud computing in the U.S. against that in the EU (where the decision did not have bearing) both before and after the *Cablevision* decision by employing a differences-in-differences approach.

In 2006, Cablevision announced the development of a Remote Storage Digital Video Recorder (RS-DVR). Similar in operation to a traditional recorder, the Cablevision RS-DVRs allow customers to record, pause, and replay television content on a hard drive. Unlike traditional DVRs, however, in which a consumer installs and uses an appliance in their own home, the Cablevision RS-DVR was located remotely, recording to and playing back from remote servers. When a consumer hit the "record" button on their remote, the RS-DVR would start to record, just as if that RS-DVR were right in their living room. In response, a consortium of U.S. television and copyright holders filed a complaint against Cablevision in May 2006 over alleged copyright infringement.

In March 2007, the District Court declared a summary judgment against Cablevision.[4] As the appellate court subsequently narrated:

> [P]laintiffs successfully argued that Cablevision's proposed system would directly infringe their copyrights in three ways. First, by briefly storing data in the primary ingest buffer and other data buffers integral to the function of the RS-DVR,

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[3] The current suits being brought against DISH by major networks are another important legal matter with respect to third-party copyright infringement is; however, we do not analyze the impact of these suits since they have yet to be resolved.

[4] *Twentieth Century Fox Film Corp. v. Cablevision Sys. Corp.*, 478 F. Supp. 2d 607 [S.D.N.Y. 2007].

> Cablevision would make copies of protected works and thereby directly infringe plaintiffs' exclusive right of reproduction under the Copyright Act. Second, by copying programs onto … hard disks …, Cablevision would again directly infringe the reproduction right. And third, by transmitting the data … to … customers in response to a "playback" request, Cablevision would directly infringe plaintiffs' exclusive right of public performance.[5]

This decision attracted relatively little attention from the media and blogs, in large part because it was consistent with a series of earlier rulings that restricted the ability of third parties to distribute copyrighted material without authorization. For instance, in a 1991 case which anticipated many of the issues in the *Cablevision* case, a district ruled in favor of seven major movie companies in a dispute with a firm that developed a system for the electronic delivery of movie video tapes.[6] Despite the fact that the firm, On Command, had legally purchased the videotapes that it transmitted to hotel guests, the court found that the firm's system infringed the studio's copyrights because it electronically transmitted the movies to hotel rooms (as opposed as physically renting the cassettes).

In August 2008, the District Court decision in *Cablevision* was reversed on appeal by the Second Circuit Court of Appeals.[7] The Circuit Court held that Cablevision's RS-DVR system did not infringe the plaintiffs' rights of reproduction and public performance on any of the three claimed grounds. The original decision was reversed, vacated, and sent back to be reconsidered by the lower court. In June 2009, the Supreme Court refused to hear the case, thereby effectively finalizing the Second Circuit's decision.

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5 *Cartoon Network, LP v. CSC Holdings*, 536 F.3d 121 [2d Cir. 2008].
6 *On Command Video Corp. v. Columbia Pictures Industries*, 777 F. Supp. 787 [N.D. Cal. 1991].
7 *Cartoon Network, op. cit.*

Because the Supreme Court never heard the appeal, the decision was only binding to the Second Circuit. But the decision was influential nationally, due to the historical sway that the circuit as had in copyright cases. As Carter [1991] argues:

> The Second Circuit is widely recognized as the nation's most important copyright court. Centered in the capital city of publishing and the arts, and mindful of the proud tradition of copyright scholars who have formed its treasure of precedent, the court regularly hears appeals raising issues in the forefront of copyright developments. The Second Circuit is not shy about its historic leadership role in shaping U.S. copyright law.

Moreover, the decision was particularly influential because the Second Circuit has historically been seen as sympathetic to copyright owners (as opposed to the 9th Circuit, based in San Francisco, which was seen as more sympathetic to firms seeking to exploit copyrighted material). The fact that this decision went "against the grain" by limiting the property rights of the copyright owners in favor of cloud firms lent it particular importance. Perhaps most importantly, the decision was the first in this area: such decisions are widely understood to have significant "persuasive authority" in other jurisdictions.[8]

Consequentially, at the time of the decision, the ruling was perceived as likely to positively impact firms focusing on cloud computing. To cite two contemporaneous accounts:

- The Cablevision ruling is good for IT companies moving into cloud computing, said Dow Lohnes PLLC attorney James Burger, who represents technology companies in IP and content licensing matters. If the court had found Cablevision guilty of direct infringement for giving its customers the RS-DVR data storage system, system operators storing consumers' legally acquired entertainment media in the internet cloud could have faced the same claims.[9]
- [A] rule holding Cablevision liable merely because it housed and maintained the servers in this case could imperil a wide variety of innovative business models that rely on the use of remote computing, ranging from examples like

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[8] This may be partially attributed to a "bandwagon effect," and partially because reach a different outcome would create a "circuit split" that invites Supreme Court review, and thus dramatically increases the odds of a reversal of the decision, an outcome most judges try hard to avoid.

[9] Standeford [2009].

> Internet-enabled self-service photo processing and printing, to cloud computing services offered by companies like Amazon, Apple and Google.[10]

Conversations with a number of venture investors suggest that the *Cablevision* decision led to increased VC investment in cloud computing in the U.S. relative to other counties where no comparable shift of copyright protection occurred.[11] Prior to this decision, venture investors feared that record labels, movie studies, and other content owners might sure cloud-computing start-ups for copyright infringement, based on their users storing and accessing legally acquired copies of protected content. Trade associations such as the Recording Industry Association had made substantial investments in ferreting out infringing materials on platforms such as Pirate Bay, and the investors feared that the start-ups could readily get caught up in litigation with content owners. These concerns were exacerbated by the experience of investors in Napster. The firm's corporate and independent venture investors were sued by major recording companies, who argued that the investors were liable for copyright infringement because they had effective control of Napster. After the federal courts refused to dismiss the claims, the investors settled the case in 2006 and 2007, collectively making what has been estimated to be a nine-figure sum [Ottaviani, 2007]. As Ottaviani [2007] noted,

> The decision caused a great deal of discomfort among those firms, in the private equity community dealing with content distribution companies. Investors were forced to review and rethink commonly used structures to control a portfolio company, and evaluate whether and how those control structures exposed the investors to liability for copyright infringements of the portfolio company.

It might be thought that these startups could obtain licenses from content providers to immunize themselves from such fears, but the transaction costs of such licensing arrangements, our

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[10] Kwun [2008].

[11] While there have been several copyright cases against online video recording service providers in Europe, we are unaware of any that has resolved such substantial uncertainty with respect to reproduction and retransmission rights in favor of such service providers as the *Cablevision* decision has in the U.S.

informants reported, were prohibitive. The costs reflected both the complexity of the rights holdings and the suspicion of the intellectual property owners regarding the intentions of venture-backed firms.

Two caveats should be noted. First, it is important to note that to the extent that U.S.-based firms also do business in the rest of the world, or EU firms do business in the U.S., such international activity will dampen the hypothesized effect since the Internet is affected by both local and non-local regulations, and thus any estimates of the hypothesized effect are likely to be conservative. (It should be noted that in many cases foreign courts have deferred to the laws in which an Internet company is based when ruling on disputes involving these firms (Chander [2012])).

Second, the Supreme Court addressed similar issues in June 2014,[12] when it reversed an appellate court decision and concluded that the firm Aereo publicly performs copyrighted works, in violation of the Copyright Act, when it sells its subscribers a service that allows them to watch television programs over the Internet at about the same time as the programs are broadcast over the air. This decision was seen as reintroducing substantial uncertainty into the breadth of copyright protection [Stoltz, 2014].

2.3. The French Litigation: M6, W9, France Television, TF1, and NT1 v. Wizzgo (2008)

In Section 5, we will also examine the impact of decisions in the French and German courts relative to those elsewhere in Europe. In May 2008, Wizzgo launched the first online DVR platform in France, which allowed users to view recorded copies of programs broadcast on domestic terrestrial television channels as long as they requested that the show be recorded

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[12] *American Broadcasting Companies v. Aereo*, 573 U.S. ___ (2014).

before the programs started.[13] The copy was a faithful reproduction and included the original advertising.[14] In response, a consortium of French television and copyright holders, including M6, W9, France Television, TF1, and NT1, filed complaints against Wizzgo over alleged copyright infringement.

Wizzgo argued that its technological platform fell under two exceptions in French copyright law: transience and privacy copying. First, Wizzgo claimed that it provided users with a temporary and transient copy of a program, and only assisted users in saving private copies. Second, Wizzgo claimed that each copy of a recorded program was private. In France, copying copyrighted work strictly for personal use falls under the private copy exception as long as the copyist and the user of the copy are the same person.[15] Throughout August and November 2008, the Tribunal de Grande Instance de Paris issued a series of injunctions, banning Wizzgo from using the plaintiffs' copyrighted works.[16] On November 25, 2008, the Tribunal de Grande Instance de Paris declared the final set of summary judgments against Wizzgo and levied a fine.[17] In response to the court's ruling and the fine ordered by the court, Wizzgo and similar companies halted operations.[18] Outside sources suggest that the French litigation is likely to have a negative impact on VC investment and to delay the development of related technology, such as cloud computing services. For example, a paper by European Digital Rights states that "[t]he [Wizzgo] case is a relevant example to further corroborate the idea that the current EU copyright

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13 International Law Office [February 19, 2009].

14 Wizzgo [2009].

15 International Law Office [February 19, 2009].

16 The Tribunal de Grande Instance issued five summary judgments against Wizzgo: (1) *Metropole Television v. Wizzgo* [August 6, 2008]; (2) *France 2 v. Wizzgo* [November 6, 2008]; (3) *TF1 v. Wizzgo* [November 6, 2008]; (4) *NT1 v. Wizzgo* [November 10, 2008]; and (5) *Metropole Television v. Wizzgo* [November 25, 2008]. International Law Office [February 19, 2009]; and ZDNet.fr [November 14, 2008].

17 International Law Office [February 19, 2009].

18 "The court ordered compensatory damages of more than €440,000 against Wizzgo for copyright infringement, which convinced other French online DVR platforms immediately to cease similar services." (International Law Office [February 19, 2009]).

policy hinders technology."[19] Some members of the popular press was similarly disappointed; for example, one member wrote that "[b]y closing the door to the Wizzgo arguments […] and the evolution of technology and uses, the French justice system is particularly reactionary and conservative."[20] Given the view that the French ruling was likely to have a negative impact on related technologies, it is logical to hypothesize that this ruling would lead to decreased VC investment in cloud computing in France relative to other counties in the EU.

2.4. The German Litigation: RTL et al. v. Shift.tv and Save.tv

Shift.tv, founded in 2005, and Save.tv, founded in 2006, are subscription-based services that allow customers to select and store television content on servers from which users can download and stream stored programs.[21] Online video recording platform service providers operate sites that facilitate the receipt of TV signals through satellite reception stations, and transform and store these signals in customer-dedicated server space.[22] Customers select the content to be stored and can download and/or stream the content. In response to the services offered by these companies, two German television channels, RTL and SAT1, began judicial action claiming that the services constituted copyright infringement.[23]

A German District Court found that both Shift.tv and Save.tv infringed plaintiffs' reproductions rights by storing and copying the data streams provided by the plaintiffs on servers for playback by customers, on May 12, 2006 and May 9, 2007, respectively. The Dresden Court of Appeals ruled against Shift.tv on November 28, 2006, yet in favor of Save.tv on October 9,

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19 European Digital Rights [2011].

20 "En claquant ainsi la porte à l'argumentaire de Wizzgo […] et l'évolution des technologies et des usages, la justice française se montre particulièrement rétrograde et conservatrice." (Caruana [2008]).

21 Poschenrieder [2008]; and International Law Office [June 11, 2009].

22 Bird and Bird [2009].

23 Three lawsuits: *SAT1 v. Shift.tv*; *RTL v. Shift.tv*; and *RTL v. Save.tv*. (See IRIS Legal Observations of the European Audiovisual Observatory [2011]).

2007.[24] On April 22, 2009, the Federal Court of Justice repealed both rulings and remanded them to the Dresden Appeals Court.[25] In doing so, the Federal Court of Justice considered the recording process and ruled on two issues: the right of reproduction and the right of retransmission. To the court, it was unclear whether Shift.tv and Save.tv recorded broadcasts on behalf of its users, or if the technology was automatic and users themselves recorded the programs. If the copying was not automatic, the Federal Court ruled that Shift.tv and Save.tv would be liable for direct infringement of reproduction rights. Even if the copying was fully automatic, the defendants could be liable for infringement of the plaintiffs' retransmission rights to the public, which are harmed by retransmitting broadcasting signals simultaneously to a large number of customers.[26] Thus, the Federal Court instructed the Appeals Court, on a case-by-case basis, to rule on whether the reproduction process is automated and to clarify the extent to which the plaintiffs infringed retransmission rights.[27]

In July 2011, the Dresden Appeals Court ruled in favor of Save.tv and found that its online video recorder did not infringe RTL's rights of reproduction, though a similar ruling has not been reached for Shift.tv. The court found that from a technical standpoint, the user initiates an automated recording process to create a private copy of a television program.[28] However, the court did not resolve the issue of retransmission rights infringement.[29] As such, Save.tv requires a license for retransmission from RTL, yet it has been unable to do obtain such a license.[30] Thus,

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[24] Burghart [2010]; International Law Office [June 11, 2009]; IRIS Legal Observations of the European Audiovisual Observatory [2011]; and "OLG Dresden 14 U 801/07 Urteil vom 12.07.2011."

[25] International Law Office [2009]; and IRIS Legal Observations of the European Audiovisual Observatory [2011].

[26] Burghart [2010]; and, Bird and Bird [2009].

[27] IRIS Legal Observations of the European Audiovisual Observatory [2011].

[28] *Ibid*.

[29] *Ibid*.

[30] VG Media, the German royalty collecting society, refused to grant Save.tv the necessary licenses to operate its business, arguing that online video licenses are not covered by its agreement with German broadcasters. (See

while Save.tv was not found liable of direct infringement, German law has blurred the issue by neither ruling completely in favor nor completely against companies like Save.tv and Shift.tv. While Save.tv does not infringe reproduction rights, the German courts have ruled that television channels can prevent these businesses from operating by refusing to issue licenses for retransmission.

While both Save.tv and Shift.tv continue to operate in Germany, outside sources suggest that the German litigation—by raising questions about the allocation of copyright protection—is likely to have a negative impact on investment in this and related technologies, such as cloud computing services. For example, "[a]lthough the Federal Court of Justice referred the case back to the Court of Appeal, it is already clear that the business model of Internet-based video recording can be operated legally only with the broadcasters' prior permission. It is doubtful whether a service operated on this basis can be profitable."[31] The popular press also reacted negatively: "[N]ew technology and innovation are impeded by [the 2009 judgment], which unnecessarily increases the technical deficits of Germany compared to other Internet-nations."[32] As with the French ruling, given the view that the German rulings were likely to have a negative impact on related technologies, it is logical to hypothesize that these rulings would lead to decreased VC investment in cloud computing in Germany relative to other counties in the EU.

IRIS Legal Observations of the European Audiovisual Observatory [2011]). In a November 2010 ruling on the dispute, the Appeals Court of Munchen found that "RTL is entitled to prohibit Save.tv from retransmitting its programmes." (See IRIS Legal Observations of the European Audiovisual Observatory [2011]).

31 International Law Office [June 11, 2009].

32 "Moderner Technik und Innovation wird damit seiner Ansicht nach ein Riegel vorgeschoben, der die technischen Defizite Deutschland gegenüber anderer Internet-Nationen nur unnötig steigert. Mit dem neusten Urteil hingegen sei endlich ein Startschuss für weitere Entwicklungen gefallen." (See TVAnbieter.de [July 25, 2011].)

2.5. Event Study Evidence

One way to validate the impact of these judicial decisions on cloud companies is to examine the consequences of these decisions on publicly traded cloud-computing companies in the same country. Inasmuch as the decisions contained unexpected good or bad news, it should affect their valuation either positively or negatively.

To undertake such an analysis, we sought to identify publicly traded cloud computing companies. We identified potential cloud computing firms through Capital IQ, the *CloudTimes* "50 Top" [2010] list, IDC analyst reports, and Thomson Reuters VentureXpert. We verified from CRSP and/or Datastream that the firm was publicly traded at the time of the decisions, and from securities filings that the firm was active in the cloud computing market at that time. The sample included companies with active cloud-computing divisions but generated the bulk of their revenues in other ways (e.g., Amazon) and dedicated cloud-computing firms (e.g., Rackspace).

It proved to be much more straightforward to undertake this analysis in the United States than in France and Germany. In the United States, we were able to identify 25 companies that met our criteria. In Europe, it was much more difficult. For instance, in Germany, following the same procedure, we could identify only two borderline cases, Deutsche Telekom and SAP, which were problematic as they appeared to really get involved in cloud computing at a considerably later date. This paucity of identified firms may reflect the relative thinness of technology activity in continental Europe in this area, the difficulties that many entrepreneurial European face in going public, and the poorer representation of technology analysts and reporters on the continent.

As a result, we focused our analysis on the U.S. judicial decisions. Because of some uncertainty of the timing during the day of the release of the decisions, we looked at the cumulative abnormal returns (CARs) on the day of the decision and the day after (the [0, +1]

window). Because the "pure play" cloud companies were generally smaller in market capitalization, we focused on equal-weighted returns. For the market-adjusted model, we use a one-year estimation period, ending two months before the event.

Table 1 illustrates the key patterns. The March 2007 District Court decision was associated with negative returns, which was weakly significant in one specification. These results were consistent with press accounts that suggested that this decision largely corroborated the received wisdom about the nature of copyright protection, and thus contained limited news. The August 2008 Second Circuit decision, on the other hand, had a substantial positive effect. Not only was the absolute magnitude of the effect stronger (a positive CAR of +1.2% and 1.4%), but the four tests are consistently significant at the 5% confidence level, and in three cases at the 1% level.

3. Data

3.1. Venture Capital Funding Data

In order to examine the differences in how VC investment in cloud companies varies between the U.S. and EU, and between France and Germany and other EU countries, we constructed a dataset that draws on historical investment figures captured by VentureXpert.[33] VentureXpert is one of the two most widely-used databases of VC investments in the U.S. and EU.[34] It contains data on approximately 1.2 million global private companies and over 25,000 venture, buyout, and mezzanine funds.[35]

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[33] More specifically, the Thomson ONE's Private Equity module powered by VentureXpert was used.
[34] Maats et al. [2009].
[35] Thomson Reuters factsheet [2011].

The dataset uses all private equity investments in the Thomson database from the beginning of 1995 through the end of 2010 classified as "Venture Capital Deals"[36] involving a portfolio company with a business description including the term "cloud." These criteria yielded data on investments in 280 companies. Independent research identified an additional 216 cloud computing-related companies,[37] 59 of which received VC investment from 1995 through 2010 captured in VentureXpert. Seventy-nine companies were removed from the list of 339 (280 + 59) companies appearing in VentureXpert based upon review of their business descriptions, and 17 were removed for lack of any data on investment amount.[38] As a result, the final dataset contains data on VC investments in 243 cloud computing companies.[39]

The unit of observation in the data extracted from VentureXpert is an investment by a particular VC fund into a particular portfolio company on a particular date. The dataset contains 2,009 observations on investments by 706 distinct funds into the 243 companies on 587 different dates. These data were then aggregated by calendar quarter of investment date by region (U.S., EU, and the rest of the world for the analysis of the *Cablevision* decision, and France, Germany, EU, and the rest of Europe for the analysis of the French and German rulings).

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[36] Venture capital investments include start-up, seed, and early, expansion, and later stage deals.

[37] This researched involved the review of numerous sources, including: Corbin [2011]; "The Top 20 Software as a Service (SaaS) Vendors," http://www.clouds360.com/saas.php; "The Top 20 Infrastructure as a Service (IaaS) Vendors," http://www.clouds360.com/iaas.php; "The Top 20 Platform as a Service (PaaS) Vendors," http://www.clouds360.com/paas.php; Kirilov [2011]; Geelan [2009]; "50 Top Cloud Computing Companies," http://www.cloudtweaks.com/2010/07/over-50-of-the-biggest-and-best-cloud-computing-companies, [2010]; Depena [2011]; Singh [2009]; and, "List of Top 'Cloud Computing Solution Providers to Watch in 2009," http://www.oncloudcomputing.com/en/2009/07/list-of-top-cloud-computing-solution-providers-to-watch-in-2009/, [2009].

[38] Business descriptions from VentureXpert, Bloomberg, the company websites, and news stories were reviewed. Companies were excluded if cloud computing did not appear to be a primary part of their business or their business appeared to focus on pushing non-user-generated content to from the cloud to users (*e.g.*, security updates, games, licensed media content).

[39] In identifying cloud computing companies for our analysis, we carefully reviewed all business descriptions as well as, when possible, company websites to ensure that the company was primarily a cloud computing company and that the company's business was one that had the potential to be affected by the rulings in France, Germany, and the U.S.

Appendix A summarizes the data used in the analysis of the *Cablevision* decision. As it shows, total VC investment in the identified U.S. cloud companies from the first quarter of 1995 to the end of 2010 amounted to $5.9 billion. This reflects average quarterly investment of $92.3 million over that time period. In the period immediately preceding the *Cablevision* ruling (Q1 2006 to Q2 2008), average quarterly investment in U.S. venture-backed cloud companies was $131.0 million, and subsequent to the ruling, that figure amounted to $184.7 million. Thus, average quarterly investment in U.S. cloud computing increased by approximately 41 percent after the *Cablevision* decision. Appendix A further shows that VC investment in the identified EU cloud companies from the first quarter of 1995 to the end of 2010 amounted to $242.3 million. This reflects average quarterly investment of $3.8 million over that time period. In the period immediately preceding the *Cablevision* ruling (Q1 2006 to Q2 2008), the average quarterly investment in EU venture-backed cloud companies was $7.0 million, and subsequent to the ruling, that figure amounted to $8.9 million. Thus, average quarterly investment in EU cloud computing increased by approximately 27 percent, as compared with 41 percent in the U.S., after the *Cablevision* decision.

Appendix B summarizes the data used in the analysis of the French rulings for three time periods: (1) the entire period for which data from VentureXpert were obtained (Q1 1995 to Q4 2010), (2) a short period preceding the Wizzgo ruling (Q1 2006 to Q4 2008), and (3) a short period following the ruling (Q1 2009 to Q4 2010). We focus on relatively short periods around the ruling to mitigate the bias that could be introduced from long-term investment trends prior to 2006.

In the period immediately preceding the Wizzgo ruling, there were no VC investments in French venture-backed cloud companies, and subsequent to the ruling, the average quarterly VC

investment in French cloud companies was $0.45 million. In the EU as a whole,[40] for the period immediately preceding the Wizzgo ruling, the average quarterly VC investment in cloud companies was $5.9 million. Subsequent to the ruling, the average quarterly VC investment in EU cloud companies was $9.8 million.

Appendix C summarizes the data used in the analysis of the German rulings for four time periods: (1) the entire period for which data from VentureXpert were obtained (Q1 1995 to Q4 2010), (2) a short period preceding the 2006 German District Court ruling (Q1 2004 to Q2 2006), (3) a short period following the ruling (Q3 2006 to Q4 2008), and (4) a longer period following the ruling (Q3 2006 to Q4 2010). As with the French ruling, we focus on relatively a short period around the 2006 German District Court ruling (Q1 2004 to Q4 2008) to isolate the effect of this ruling as well as the other similar rulings discussed above that occurred in 2006 and 2007. We also investigate the effect over a longer time period (Q1 2004 to Q4 2010) since the litigation involving Shift.tv and Safe.tv, to our knowledge, has not yet been completely resolved. Thus, uncertainty likely exists regarding the viability of certain cloud computing business models in Germany.

In the period immediately preceding the 2006 German District Court ruling (Q1 2004 to Q2 2006), there were no investments in German venture-backed cloud companies, while the average quarterly VC investment in EU cloud companies was $3.5 million. Subsequent to the ruling, for the shorter period Q3 2006 to Q4 2008, there were also no investments in German venture-backed cloud companies, while EU cloud computing companies received average quarterly VC investment of $6.9 million. For the longer period Q3 2006 to Q4 2010, the average quarterly VC

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[40] All other EU countries during the period under study were included: Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

investment in German cloud companies was $0.30 million, while EU cloud computing companies received average quarterly VC investment of $8.2 million.

3.2. Supplemental Data

We augment the VC funding data with data on other factors that could influence investors' decisions to invest in cloud computing specifically, and in other sectors more generally. Such factors include macroeconomic conditions reflected in gross domestic product (GDP) measures and the feasibility of cloud computing as measured by broadband penetration.

Our GDP data are quarterly growth rates of real, seasonally adjusted GDP as a percent change over the previous quarter from the OECD.[41] These data are available for the U.S. from Q1 1995 through Q2 2011, and for the EU (27 countries), including France and Germany, from Q2 1995 through Q2 2011.

Data on broadband penetration, which is equal to the number of broadband subscriptions per 100 inhabitants, was obtained from the OECD for the U.S. and 21 of the 27 EU member states from Q2 2002 through Q4 2010.[42] To calculate an EU-specific measure of broadband penetration in each period, the broadband penetration rate of each EU member state was multiplied by its corresponding annual population to obtain the number of broadband subscribers. Next, the total number of EU broadband subscribers was obtained by summing over all EU member states; this total was then divided by the total EU population to obtain an EU-specific measure of broadband penetration. Finally, quarterly broadband penetration rates were calculated by linearly interpolating the semi-annual series.

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[41] Data accessed through http://stats.oecd.org.
[42] Data accessed through http://stats.oecd.org.

These supplemental data are summarized in Appendix A for the U.S., Appendix B for France, and Appendix C for Germany.

4. Estimation and Results – The *Cablevision* Decision

We first examine whether investment in venture-backed U.S. cloud companies shifted subsequent to the Q3 2008 *Cablevision* appeals court ruling. Each of these analyses are variants of difference-in-difference regression frameworks that rely on historical VC investment in both the U.S. and EU as controls in order to identify any statistically significant increase in VC investment in U.S. cloud companies post-*Cablevision*.

Our initial set of regression analyses are variants of the following regression model that accounts for the impact of a variety of factors on quarterly venture-backed investment in the identified cloud companies:

$$VC\ Ratio_{r,t} = \beta_0 + \beta_1(U.S.\ Indicator)_r + \beta_2(Q3\ 2008\ or\ After\ Dummy)_t + \beta_3(Effect\ of\ Cablevision\ on\ U.S.\ VC\ Investment)_{r,t} + \theta X_{r,t} + \varepsilon_{r,t}. \quad (1)$$

Specifically, the dependent variable, $VC\ Ratio_{r,t}$, is VC dollars invested in the cloud computing companies in region *r* at quarter *t* divided by VC dollars invested in all information technology (IT) companies (including cloud computing) in region *r* at quarter *t*. We normalized our dependent variable this way because the volume of VC activity varies considerably over time due to factors that are largely exogenous to the issues being studied here. To cite one notable example, the volume of venture investment fell by almost 90 percent between 2000 and 2002; this decline was driven primarily by the collapse in the public valuations for internet and telecommunications stocks in 2000, and the subsequent inability of venture funds to exit many of their investments at attractive prices. In other cases, funds have flowed to particular sectors, such as cleantech, potentially crowding out investment elsewhere.

As a result, the bulk of our analyses examine VC investments in cloud computing as a share of all VC investments, though we also analyze the level of venture investment in cloud computing in a robustness check. When we replicate the results using the level of financing, we find the results go through as before.

The explanatory variable *U.S. Indicator* equals one for investment in U.S. cloud computing companies and zero for investment in EU cloud computing companies. The explanatory variable *Q3 2008 or After Dummy* equals zero for all quarters before the U.S. Appellate Court decision in the *Cablevision* case in August 2008 and one in Q3 2008 and all quarters thereafter. The explanatory variable, *Effect of the Cablevision Decision on U.S. VC Investment*, a dummy variable capturing the interaction between the *U.S. Indicator* and the *Q3 2008 Dummy*, equals one for investment in U.S. cloud computing companies in Q3 2008 and thereafter, and zero otherwise. $X_{r,t}$ is a vector of other explanatory variables, including GDP growth and broadband penetration, that may be associated with investment in cloud companies.

This difference-in-difference model is designed to estimate parameter β_3, whether investment in venture-backed U.S. cloud companies rose subsequent to the *Cablevision* decision, controlling for trends in the U.S. relative to EU (captured by *U.S. Indicator*), and trends in cloud computing generally (captured by *Q3 2008 or After Dummy*) absent the policy.

In order to focus more narrowly on the time period surrounding the *Cablevision* decision, our analyses focus on investment levels from 2006 to 2010. Doing so eliminates long-term investment trends prior to 2006 from influencing the results. Figure 1, which depicts the quarterly difference between investment in U.S. and EU venture-backed firms, suggests that investment in U.S. venture-backed cloud companies was not systematically increasing, relative to EU firms, in the time period immediately preceding the 2008 *Cablevision* ruling; however,

investment in U.S. venture-backed cloud companies increased, relative to EU firms, after the 2008 *Cablevision* ruling.[43]

Our first set of regression results are presented below in Table 2, and show that investment in venture-backed cloud computing companies is significantly higher in the U.S. than in the EU after the *Cablevision* decision.[44] The coefficient on β_3 in Model 1, which provides an estimate of the change in VC investment post-*Cablevision*, is equal to 0.0257. It indicates that the rise in average VC investment in cloud computing in the U.S. as a percentage of VC investment in IT in the U.S. from the period Q1 2006 through Q2 2008 to the period Q3 2008 through Q4 2010 was approximately 2.57 percent greater than the corresponding rise in cloud computing investment in the EU, or approximately 3.16 percent overall.[45] This estimate of β_3, statistically significant at the 95 percent confidence level, implies an approximately $730 million increased VC investment in U.S. cloud computing companies after the *Cablevision* decision.

Model 2 is similar to Model 1, except that it incorporates variables that control for GDP growth and broadband penetration. As shown in column 2 of Table 2, the coefficients on these

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[43] Figure 1 shows that the increase in VC investment in the U.S., relative to the EU, did not occur immediately after the 2008 *Cablevision* ruling. Such a delay is consistent with both the typical amount of time required to obtain VC investment and the fact that VC investment often involves multiple rounds of increasing size. Specifically, the VC investment process typically takes between 6 and 12 months (Madison Park Group [2008]) and a firm receiving VC investment may receive multiple rounds, with the average investment size in the first round equal to between $6 and $13 million, the average in the second round equal to between $8 and $15 million, and the average in later-stage rounds equal to between $15 and $23 million (Huggett [2012]). In addition, there are gaps between each round, with the average time between rounds of financing in 2010 equal to approximately 20 months (Sherman [2012]).

[44] Around the time of the *Cablevision* decision, some cloud services were launched, such as Microsoft Windows Azure on November 17, 2009 ("Microsoft Cloud Services Vision Becomes Reality With Launch of Windows Azure Platform," http://www.microsoft.com/en-us/news/press/2009/nov09/11-17pdc1pr.aspx), and these services may have had an effect on VC investment in cloud computing in the U.S. However, other cloud services, such as Amazon EC2 and Google Apps and Docs were launched much earlier in 2006, and appeared to have little or no effect on VC investment in the U.S. ("Google Introduces New Business Version of Popular Hosted Applications," http://googlepress.blogspot.com/2007/02/google-introduces-new-business-version_22.html; http://aws.amazon.com/about-aws/whats-new/2006/; and, "Google Announces Google Docs & Spreadsheets," http://googlepress.blogspot.com/2006/10/google-announces-google-docs_11.html.) Furthermore, any cloud services that were launched around the time of the *Cablevision* decision may have been in part launched because of the clarity afforded by the decision.

[45] $\beta_2 + \beta_3 = 0.0059 + 0.0257 = 0.0316$.

variables have the expected positive sign and are statistically significant. Interpretation of the other variables remains the same, and as shown in the table, the magnitude and significance of the *Effect of Cablevision on U.S. VC Investment* is almost identical to the magnitude and significance of the *Effect of Cablevision on U.S. VC Investment* in Model 1. The implied increase in U.S. VC investment of approximately $728 million is nearly identical as well.

To investigate the potential impact of outliers on our analysis, we ran Models 1 and 2 using a difference-in-difference quantile regression analysis. Quantile regression analysis allows one to estimate the relationship between a set of independent variables and a specific quantile, or percentile, of the response variable. One advantage of such an analysis is that the influence of large outliers is mitigated. Thus, for our context, it allows us to determine the extent to which our results are sensitive to quarters with very large or very small values of the dependent variable, *VC Ratio*. Results for median (quantile) difference-in-difference regressions are presented in Table 3.

Results for Model 3, the quantile regression version of Model 1, are presented in Table 3. These results are similar to those presented in Table 2 and imply that the rise in median (as opposed to average) VC investment in cloud computing in the U.S., as a percentage of VC investment in IT in the U.S. from the period Q1 2006 through Q2 2008 to the period Q3 2008 through Q4 2010, was approximately 3.5 percent greater than the corresponding rise in cloud computing investment in the EU. This estimate, which is statistically significant at the 95 percent confidence level, implies an approximately $952 million increase in VC investment in U.S. cloud computing companies after the *Cablevision* decision.

Results for Model 4, the quantile regression version of Model 2, are also presented in Table 3, and are similar to those for Model 3 with an implied increase in U.S. cloud computing investment of approximately $904 million.

4.1. Additional Sensitivity Analyses and Robustness Checks

4.1.1. Alternative Control Group Specifications

We have also estimated a difference-in-difference model comparing investment in the U.S. to investment in the rest of the world (ROW) in order to examine whether the results are sensitive to the use of EU companies as a control group. Specifically, we have conducted analyses analogous to Model 1 using ROW investment (rather than investment in the EU) as a benchmark.

As an alternative approach to examining the robustness of our findings, we have examined the extent to which investment levels increased subsequent to the *Cablevision* ruling for a broad set of internet companies, rather than just the cloud companies included in the above analyses. We anticipate that there will be no effects for this set of internet companies since the Cablevision ruling should only affect cloud computing companies. The results associated with Models 5 and 6 presented in Table 4, are analogous to Models 1 and 2 except that they are run on the "internet-specific" companies rather than the cloud companies.[46]

As the results in Table 4 show, investment levels in U.S. internet-specific companies either actually *decrease* in the U.S. following the Cablevision decision (Model 5), or are not statistically different in the time periods before and after the *Cablevision* ruling (Model 6). This suggests that the findings described above are specific to cloud companies, in particular, and do

[46] VentureXpert categorized 8,510 companies as being internet-specific. This list includes companies described as "internet communications," "e-commerce technology," "computer hardware," "internet software," "internet programming," "internet ecommerce," "internet content," and "internet services."

not reflect general trends associated with venture-backed investment in internet-specific companies.[47]

4.1.2. Stationarity[48]

One assumption made in our regression analyses is that the data are stationary; that is that the data series do not depend on time and thus, that the mean, variance, and covariance of the data do not vary with time. To examine the extent to which increased U.S. investment subsequent to the *Cablevision* decision reflects an ongoing trend, perhaps attributable to factors not reflected in any of the data we collected, we have conducted a variety of tests. First, we ran a simple ordinary least squares regression on the difference between U.S. and EU investment levels against a time trend; this revealed that U.S. investment levels relative to EU investment levels were falling on average, but not significantly, during the Q1 2006 to Q3 2008 time period.

To more formally test for stationarity in our time series data, we conducted three well-known tests on our data from Q1 2006 through Q4 2010: the Dickey-Fuller, Phillips-Perron, and Kwiatkowski–Phillips–Schmidt–Shin tests. Using each test, we found no evidence of non-stationarity. As such, our data appear to be stationary, and thus, it is not necessary to adjust our regression equations or data.

4.1.3. Autocorrelation

We also tested for the presence of autocorrelation in our regression analyses by conducting a test proposed by Jeffrey Wooldridge for panel data.[49] After correcting for autocorrelation, the

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[47] We also undertake a variety of unreported robustness checks. These include using the logarithm of venture financing as a dependent variable, as more detailed controls for country and industry. The results are robust to these alterations.

[48] A stationary time series is one whose statistical properties such as mean, variance, and autocorrelation, are all constant over time. Most statistical methods are based on this assumption, and violations of stationarity can lead to biased point estimates.

[49] Wooldridge [2002].

estimate of the effect of Cablevision remains significant and positive, and the implied increase in U.S. cloud VC investment actually increases from that of Models 1 and 2.

4.1.4. Clustered Standard Errors

Clustering standard errors corrects for the lack of independence between observations. In our data, observations within a quarter may contain similar information. Without correcting for the non-independence of the data, the standard errors would potentially be too small, and thus the p-values would be too low. To correct for this, we clustered our standard errors by quarter. Although the p-values increase as expected, the estimate of the effect of Cablevision remains significant. Specifically, as Table 5 shows, the estimate of the effect of Cablevision remains significant in both Models 7 and 8 these models are analogs to Models 1 and 2, with the only difference being that the standard errors are clustered by quarter.

4.1.5. Tobit Regression Model

Given the fact that many of the observations in our dependent variable are equal to zero (32.8 percent), we run a Tobit model in an unreported analyses to account for potential censoring. Doing so, we find that the estimate of the effect of Cablevision remains significant and positive in Models 1 and 2. When Model 1 is run using ordinary least squares, we find that the coefficient on the effect of Cablevision is equal to 0.0257 and is significant at the five percent level. When we instead use a Tobit model, the coefficient on the effect of Cablevision is equal to 0.0241 and is significant at the ten percent level. When we rerun Model 2 using a Tobit model, the estimate of the effect of Cablevision decision also remains significant.

4.1.6. Investment Levels (vs. Ratios)

We ran additional sensitivities based on an alternate specification of the dependent variable. Specifically, we ran regressions analogous to Models 1 and 2 but where the dependent

variable was the total quarterly investment (in the U.S. or EU) measured in dollars, rather than measured in terms of a ratio relative to total IT spending. The total other IT VC investment and total other VC investment in a given region were controlled for by their inclusion as separate independent variables in the regression analysis. These regressions yielded results, presented in Table 6, comparable to those of Models 1 and 2.

In Model 9, the analog to Model 1, U.S. investment was, on average, $119 million higher each quarter after the Cablevision ruling (after controlling for EU differences), totaling $1.2 billion over the 2.5 subsequent years. The corresponding figures for Model 10 the Model 2 analog, which incorporates controls for GDP changes and broadband penetration, imply $126 million higher investment on a quarterly basis and $1.3 billion in total for the 2.5 years.

4.1.7. Investment Events (vs. Investment Ratios or Investment Levels)

We next ran regressions analogous to Models 1 and 2 where the dependent variable was whether a given VC deal was a cloud deal or not, rather than total quarterly investment measured in dollars or the ratio of total quarterly investment relative to total IT spending. In running these regressions, we used a logit model where, if a deal was a cloud deal, the binary dependent variable was set equal to one; otherwise, the dependent variable was set equal to zero. Because there is a strong industry effect in venture funding—some groups specialize, for instance, in biotechnology, while others concentrate on energy--we restricted our sample to include only VC firms that had previously provided funding to a cloud company. Our results, which are presented in Table 7, indicate that the effect of Cablevision on whether a VC firm provided financing to a cloud company is generally positive and significant, and suggest that our principal results are not being driven by a small number of large VC investments.

4.1.8. Investment Rounds (vs. Investment Ratios or Investment Levels)

We also ran regressions analogous to Models 1 and 2 where the dependent variable was the number of rounds of VC investment received within a given quarter (in the U.S. or EU), rather than total quarterly investment measured in dollars or the ratio of total quarterly investment relative to total IT spending. Our results, which are shown below in Table 8, indicate that the effect of Cablevision on the number of U.S. VC investment rounds is positive and significant, and suggest that our principal results are not being driven by a small number of large VC investments. These results thus provide further evidence that decisions around copyright protection can have significant impacts on VC investment.

4.1.9. Cloud Company Identification

We have also tested the sensitivity of our results to the list of cloud computing companies included in our dataset. Our results are robust to the use of a smaller set of companies, that is, one that includes those with "cloud" in their VentureXpert business descriptions but does not include additions based on review of third party cloud computing company lists.

Our research also revealed specific types of cloud companies that are likely to be differentially affected by the *Cablevision* decision. In particular, there exist three general types of cloud computing services: infrastructure-as-a-service (IaaS), software-as-a-service (SaaS), and platform-as-a-service (PaaS). IaaS providers are the most likely to be affected by the *Cablevision* decision because their customers can store files, some of which may be copyrighted, on their servers. SaaS providers, in contrast, are the least likely to be affected by the *Cablevision* decision because they generally provide pre-packaged software solutions that are unlikely to be tasked with storing copyrighted materials on the providers' servers. And finally, PaaS providers form a middle ground between IaaS and SaaS providers in which the consumer, rather than the provider,

creates the software using tools and/or libraries from the provider. Some customers may create services that store or access copyrighted material, while others may not; thus, it is unclear whether PaaS services are likely to be affected by the *Cablevision* decision.

Table 9 provides results from three regressions where we investigate the differential impact of the *Cablevision* decision on VC investment in IaaS, PaaS, and SaaS companies. In Model 18, we run a regression in which only VC investment in IaaS companies is included in the denominator of our dependent variable, and we find results consistent with our hypothesis articulated above; that is, we find a significant and positive impact of the *Cablevision* decision on VC investment in IaaS companies. Model 19, which estimates the impact of the *Cablevision* decision on PaaS companies, also finds a significant and positive impact of the *Cablevision* decision. And finally Model 20, which estimates the impact of the *Cablevision* decision on VC investment in SaaS companies, provides results that are consistent with our expectation that SaaS companies should be unaffected; that is, we find an insignificant, although positive impact of the *Cablevision* decision on VC investment in SaaS companies. Thus, we find that those cloud companies that are the most likely to be affected by the *Cablevision* decision experience an increase in VC investment in the U.S. relative to the EU after the decision.

4.1.10. Second Circuit Court Analysis

We ran additional regressions using a logit model, similar to Models 11, 12, and 13 in Table 7, to determine whether investment in cloud companies headquartered in states under the jurisdiction of the Second Circuit Court increased compared to the rest of the U.S. The Second Circuit Court of Appeals has jurisdiction over the states of New York, Connecticut, and Vermont; since the Second Circuit Court sets binding precedent for district courts in these states, we expect to see an even bigger increase in investment in cloud companies located in these states

after the *Cablevision* decision. While this decision, as discussed above, was likely to have a broader impact, the effect of the decision should be most substantial here.

Anecdotal evidence suggests that this ruling has indeed effected firms' location decisions. For instance, high-profile (and controversial) video streaming company Aereo chose to locate in New York with a "model engineered specifically to take advantage of 2008 ruling from the U.S. Court of Appeals for the Second Circuit in a copyright case against Cablevision" (Bario [2013]).

Our results, presented in Table 10, support our hypothesis. We find a positive and significant impact of the *Cablevision* decision on investment in cloud companies in states under the Second Circuit's jurisdiction in Models 21, 22, and 23.

5. Estimation and Results – The French and German Rulings

To determine whether investment in venture-backed French and German cloud companies declined subsequent to the Wizzgo and 2006 German District Court rulings, we ran regressions similar to those that were run to analyze the impact of the *Cablevision* decision. For France:

$$VC\ Ratio_{r,t} = \beta_0 + \beta_1(France\ Indicator)_r + \beta_2(Q1\ 2009\ or\ After\ Dummy)_t + \beta_3(Effect\ of\ Wizzgo\ Decision\ on\ French\ VC\ Investment)_{r,t} + \theta X_{r,t} + \varepsilon_{r,t}. \quad (1)$$

And for Germany:

$$VC\ Ratio_{r,t} = \beta_0 + \beta_1(Germany\ Indicator)_r + \beta_2(Q3\ 2006\ or\ After\ Dummy)_t + \beta_3(Effect\ of\ German\ Decisions\ on\ German\ VC\ Investment)_{r,t} + \theta X_{r,t} + \varepsilon_{r,t}. \quad (2)$$

The dependent variable, $VC\ Ratio_{r,t}$, is VC dollars invested in the cloud computing companies in region *r* at quarter *t* divided by VC dollars invested in information technology (IT) companies in region *r* at quarter *t*, computed for both the country in question and the rest of the EU excluding France and Germany.

The explanatory variable *France Indicator* (*Germany Indicator*) equals one for investment in French (German) cloud computing companies and zero for investment in German (France) and EU cloud computing companies. The explanatory variable *Q1 2009 or After Dummy* (*Q3 2006 or After Dummy*) equal zero for all quarters before the French (German) Court ruling in November 2008 (May 2006) and one in Q1 2009 (Q3 2006) and all quarters thereafter. The explanatory variable, *Effect of Wizzgo Decision on French VC Investment* (*Effect of German Decisions on German VC Investment*), a dummy variable capturing the interaction between the *France Indicator* (*Germany Indicator*) and the *Q1 2009 Dummy* (*Q3 2006 or After Dummy*), equals one for investment in French (German) cloud computing companies in Q1 2009 (Q3 2006) and thereafter, and zero otherwise. $X_{r,t}$ is a vector of other explanatory variables including GDP growth and broadband penetration that may be associated with investment in cloud companies.

This difference-in-difference model is designed to estimate the parameter β_3, which provides an estimate of the effect of the French and German rulings on investment in French and German cloud computing, respectively, controlling for trends in France and Germany relative to the EU (captured by the country indicators), and trends in cloud computing generally (captured by *Q1 2009 or After Dummy* and *Q3 2006 or After Dummy*) absent the policy.

In order to focus more narrowly on the time period surrounding the French ruling, we analyze investment levels from 2006 to 2010. Doing so helps to eliminate long-term investment trends prior to 2006 from influencing the results. Similarly, in order to focus more narrowly on the time period surrounding the 2006 German District Court ruling, we first analyze investment levels from 2004 to 2008. We also investigate the effect over a longer time period, 2004 to 2010,

because additional court rulings were made in 2006, 2007, and 2009, and because the litigation involving Shift.tv and Safe.tv, to our knowledge, has not yet been completely resolved.

Our first set of regression results are presented below in Table 11, and show that investment in venture-backed cloud computing companies is lower in France than in the EU after the Wizzgo ruling. The coefficient on β_3 in Model 24, which provides an estimate of the effect of the Wizzgo ruling on VC investment in French cloud computing companies, is equal to -0.0185. This indicates that the increase in average VC investment in cloud computing in France as a percentage of VC investment in IT in France from the period Q1 2006 through Q4 2008 to the period Q1 2009 through Q4 2010 was approximately 1.85 percent lower than the corresponding rise in cloud computing investment in the EU. This estimate of β_3, statistically significant at the 90 percent confidence level, implies that VC investment in French cloud computing companies decreased, relative to the rest of the EU, by an average of $2.0 million per quarter after the Wizzgo ruling, or approximately $16 million in total for 2009 and 2010.

Model 25 is similar to Model 24, except that it incorporates variables that control for GDP growth and broadband penetration. As shown in column 2 of Table 11, the coefficients on these control variables have the expected positive sign and are statistically significant. Interpretation of the other variables remains the same, and as shown in the table, the magnitude and significance of the *Effect of Wizzgo Decision on French VC Investment* are almost identical to its magnitude and significance in Model 24.

Analogous regression results for Germany are presented in Table 11 and show that investment in venture-backed cloud computing companies is lower in Germany than in the EU after the 2006 German District Court ruling, both when a shorter post-ruling period is used (Q3 2006 to Q4 2008) and when a longer post-ruling period is analyzed (Q3 2006 to Q4 2010).

Model 26, which estimates the estimate of the effect of the 2006 German District Court ruling on VC investment through the end of 2008, shows that the effect of the 2006 German District Court ruling (as well as other similar rulings that followed later in 2006 and 2007) on VC investment in German cloud computing companies is equal to -0.0115. This indicates that the change in average VC investment in cloud computing in Germany as a percentage of VC investment in IT in Germany from the period Q1 2004 through Q2 2006 to the period Q3 2006 through Q4 2008 was approximately 1.15 percent lower than the corresponding rise in cloud computing investment in the EU. This estimate, statistically significant at the 95 percent confidence level, implies that VC investment in German cloud computing companies decreased, relative to the rest of the EU, by an average of $0.5 million per quarter after the 2006 German District Court ruling, or approximately $3 million in total from 3Q 2006 through 4Q 2008.

Model 27 is similar to Model 26, except that it incorporates variables that control for GDP growth and broadband penetration. As shown in column 4 of Table 11, the coefficients on these control variables have the expected positive sign. Interpretation of the other variables remains the same, and as shown in the table, the magnitude and significance of the *Effect of German Decisions on German VC Investment* is almost identical to its magnitude and significance in Model 26. The implied decrease in German VC investment is nearly identical as well.

As described above, the litigation involving Shift.tv and Safe.tv, to our knowledge, has not yet been completely resolved; as such, uncertainty likely exists regarding the viability of certain cloud business models in Germany. To investigate whether this ongoing legal uncertainty continued to depress VC investment in German cloud computing in 2009 and 2010, we also analyzed a longer post-ruling period (Q3 2006 to Q4 2010). These results, presented in Models

28 and 29 in Table 11, show that the magnitude and significance of the *Effect of German Decisions on German VC Investment* is similar to the estimates in Models 26 and 27.

5.1. Additional Sensitivity Analyses and Robustness Checks

5.1.1. Alternative Control Group Specifications

We have also estimated a difference-in-difference model comparing investment in France and Germany to investment in the rest-of-the-world (ROW) in order to examine whether the results are sensitive to the use of EU companies as a control group. Specifically, we have conducted analyses analogous to Model 24 (France) and Models 26 and 27 (Germany) using ROW investment, rather than investment in the remainder of the EU, as a benchmark. These results are presented in Table 12 and are qualitatively similar, finding that the decrease in investment in French (German) venture-backed cloud computing companies, relative to the rest of the EU, amounted to an average of $0.9 million ($0.2 million) per quarter after the Wizzgo (German) ruling.

5.1.2. Stationarity[50]

To examine the extent to which the decrease in French and German investment subsequent to the French and German rulings, relative to the EU, reflects an ongoing trend, perhaps attributable to factors not reflected in any of the data we collected, we have conducted a variety of tests. First, we ran a simple ordinary least squares regression on the difference between French and EU investment levels against a time trend, as well as on the difference between German and EU investment levels against a time trend. This revealed that French investment levels relative to EU investment levels were falling on average, but not significantly, during the pre-ruling time

[50] A stationary time series is one whose statistical properties such as mean, variance, and autocorrelation, are all constant over time. Most statistical methods are based on this assumption, and violations of stationarity can lead to biased point estimates.

period, and that German investment levels relative to EU investment levels were increasing on average, but not significantly, during the pre-ruling time period.

To more formally test for stationarity in our time series data, we conducted three well-known tests on our data: the Dickey-Fuller, Phillips-Perron, and Kwiatkowski–Phillips–Schmidt–Shin tests. Using each test, we found no evidence of non-stationarity. As such, our data appear to be stationary, and thus, we do not adjust our regression equations or data.

5.1.3. Autocorrelation

We also tested for the presence of autocorrelation in our regression analyses by conducting a test proposed by Jeffrey Wooldridge for panel data.[51] After correcting for potential autocorrelation, the estimate of the effect of the French and German rulings remains significant and negative, and the implied increase in French and German cloud VC investment is qualitatively similar.

5.1.4. Investment Levels (vs. Ratios)

We ran additional sensitivities based on an alternate specification of the dependent variable. Specifically, we ran regressions analogous to Models 24 and 25 for France, and Models 26 – 29 for Germany, where the dependent variable was the total quarterly cloud VC investment measured in dollars, rather than measured in terms of a ratio relative to total IT spending. Total other IT VC investment and total other VC investment in a given region were controlled for by their inclusion as separate independent variables in the regression analysis. The results of these regressions, presented in Table 13, show that the French and German rulings continue to have a negative and significant impact on cloud VC investment, although both the French and German results imply a larger decrease in cloud VC investment, relative to the EU, as compared to the

[51] Wooldridge [2002].

regressions in which cloud VC investment is measured in terms of a ratio relative to total IT spending.

5.1.5. Investment Rounds (vs. Investment Ratios or Investment Levels)

We also ran unreported regressions analogous to Models 24 and 26 for France, and Models 26 – 29 for Germany, where the dependent variable was the number of rounds of VC investment received within a given quarter (in France, Germany, or the EU), rather than total quarterly investment measured in dollars or the ratio of total quarterly investment relative to total IT spending. Our results indicate that the effect of the French and German rulings on the number of French or German VC investment rounds is negative and significant in Germany, and negative, although insignificant in France. This suggests that our principal results are not being driven by a small number of large VC investments and provides further evidence that decisions around copyright protection can have significant impacts on VC investment.

6. Conclusions

The impact of property rights, and in particular its implications for investment, is an important issue in corporate finance. In this paper, we set out to address the impact of these changes in one particular case: by looking at the impact of unexpected judicial decisions that shifted the allocation of copyright protection on VC investment in cloud computing companies. We do so by analyzing the joint effects of the *Cablevision* decision and the French and German rulings on VC investment in the U.S. relative to the EU and across the U.S., as well as by separately analyzing the effects of the French and German court rulings on VC investment in French and German cloud computing companies. To that end, we constructed a dataset on VC investment in cloud computing companies and estimated multiple difference-in-difference regression models.

Our findings suggest that decisions around the allocation of copyright ownership can have significant impacts on investment in innovative enterprises. Specifically, we find that the *Cablevision* decision, along with court rulings in France and Germany, led to additional incremental investment in U.S. cloud computing companies compared to the EU experience. In addition, we find that French and German court rulings led to reduced investment in French and German cloud computing companies compared to all other EU countries. The more granular analyses, such as of the impact on funding in the Second District, support that the shift in the allocation of copyright protection has a major impact on investment.

Taken together, our findings suggest that strong upstream property rights, combined with transaction costs that limited the ability to enter into licenses, can significantly deter investment in downstream innovations. We cannot assess the broader social welfare impact of these changes, since we cannot observe investment by large corporations or the long-run consequences of these shifts in property rights on the production of creative material. (Waldfogel [2011] argues that changes in effective copyright protection has had little impact on the development of high-quality popular music, but much more work needs to be done.) Nonetheless, the findings of this paper provide an empirical data point that helps illustrate an important and little studied issue.

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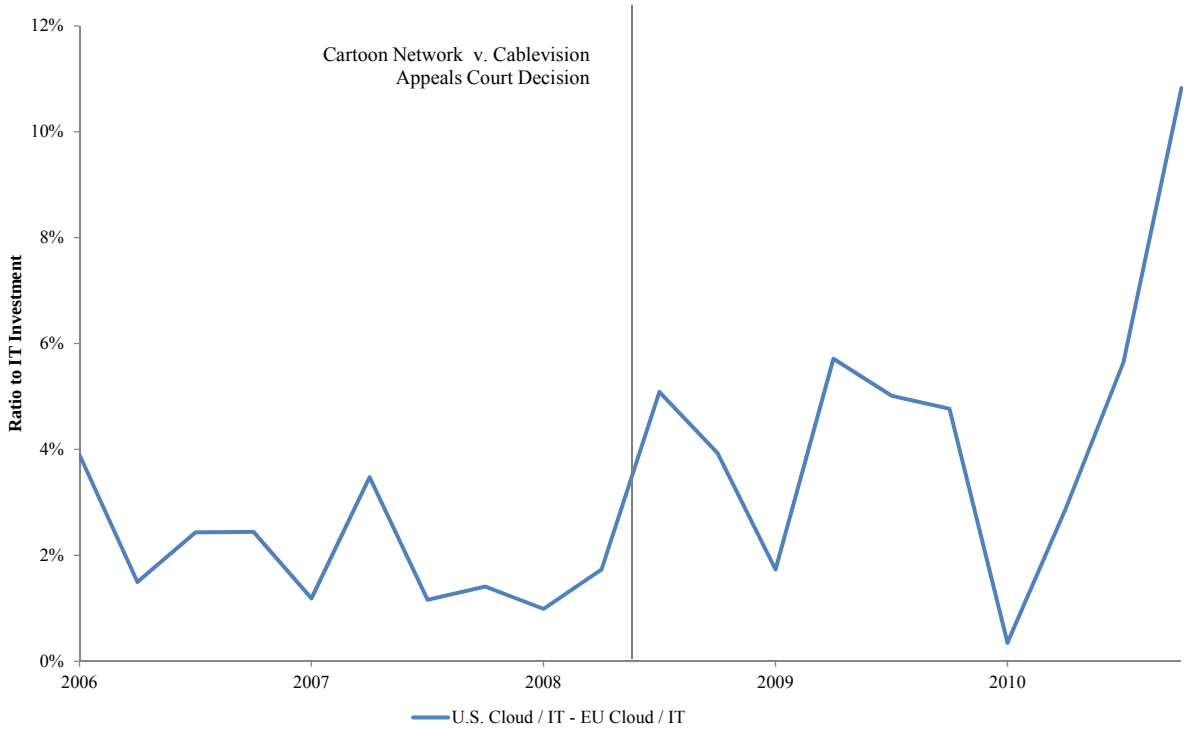
Figure 1
Difference in the Ratio of Investment in Cloud Computing Companies to Investment in all IT Companies in the U.S. and EU



Source: Private Equity Investment data Jan 2006 - Dec 2010 from Thomson ONE.

Table 1
Event Study Results: U.S. Cloud Computing Firms[1]
[0,+1] Window; Equal-Weighted Returns

	Judicial Decision	
Independent Variables	District Court	Second Circuit
Number of Observations	22	25
Market Model Returns		
Mean Cumulative Abnormal Returns	-0.57%	1.16%
Positive: Negative Ratio	7:15	18:7
p-Value, Patell z-test	0.273	0.002***
p-Value, Generalized Sign Test	0.057*	0.008***
Market-Adjusted Returns		
Mean Cumulative Abnormal Returns	-0.48%	1.36%
Positive: Negative Ratio	8:14	18:7
p-Value, Patell z-test	0.292	0.001***
p-Value, Generalized Sign Test	0.126	0.015**
Length of Time Period	March 22-23, 2007	August 4-5, 2008

Notes:
[1] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.

Table 2
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model	
Independent Variables	(1)	(2)
U.S. Indicator	0.0201***	0.0128***
	(0.0048)	*(0.0045)*
2008 Dummy[3]	0.0059	-0.0094
	(0.0080)	*(0.0090)*
Effect of Cablevision on U.S. VC Investment	0.0257**	0.0256**
	(0.0114)	*(0.0095)*
Percent Change in GDP		0.0093***
		(0.0030)
Broadband Penetration Rate		0.3743***
		(0.0900)
Constant	0.0117***	-0.0627***
	(0.0038)	*(0.0167)*
Observations	40	40
Adjusted R-Squared	0.544	0.699
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$730**	**$728**
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 3
Cloud Computing Quantile Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model	
Independent Variables	(3)	(4)
U.S. Indicator	0.0189**	0.0099
	(0.0074)	*(0.0060)*
2008 Dummy[3]	-0.0014	-0.0174
	(0.0107)	*(0.0183)*
Effect of Cablevision on U.S. VC Investment	0.0350**	0.0318**
	(0.0169)	*(0.0155)*
Percent Change in GDP		0.0058
		(0.0044)
Broadband Penetration Rate		0.3594***
		(0.0863)
Constant	0.0112*	-0.0556***
	(0.0059)	*(0.0136)*
Observations	40	40
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$952**	**$904**
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 4
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Ratio of Internet-Specific VC Dollars to Total IT VC Dollars

	Model	
Independent Variables	(5)	(6)
U.S. Indicator	0.1089***	0.0805***
	(0.0275)	*(0.0285)*
2008 Dummy[3]	0.1186**	0.0514
	(0.0446)	*(0.0575)*
Effect of Cablevision on U.S. VC Investment	-0.0852*	-0.0789
	(0.0491)	*(0.0503)*
Percent Change in GDP		0.0150
		(0.0147)
Broadband Penetration Rate		1.2788***
		(0.4496)
Constant	0.2030***	-0.0401
	(0.0238)	*(0.0809)*
Observations	40	40
Adjusted R-Squared	0.302	0.365
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 5
Cloud Computing Regression Results with Clustered Standard Errors:
U.S. vs. EU[1,2]
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model	
Independent Variables	(7)	(8)
U.S. Indicator	0.0201***	0.0128***
	(0.0010)	*(0.0010)*
2008 Dummy[3]	0.0059	-0.0094
	(0.0057)	*(0.0068)*
Effect of Cablevision on U.S. VC Investment	0.0257*	0.0256*
	(0.0109)	*(0.0111)*
Percent Change in GDP		0.0093**
		(0.0018)
Broadband Penetration Rate		0.3743***
		(0.0234)
Constant	0.0117***	-0.0627***
	(0.0026)	*(0.0040)*
Observations	40	40
Adjusted R-Squared	0.579	0.738
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$730**	**$728**
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Clustered standard errors (by quarter) are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 6
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Cloud Computing VC Dollars

	Model	
Independent Variables	(9)	(10)
IT U.S. Minus Cloud VC Investment	0.0531	0.0586**
	(0.0325)	*(0.0264)*
Total VC Investment Minus IT Minus Cloud VC Investment	0.0090	0.0002
	(0.0105)	*(0.0112)*
U.S. Indicator	-71.3537	-87.3035
	(108.3648)	*(84.2297)*
2008 Dummy[3]	7.4676	-23.4116
	(8.8497)	*(26.4662)*
Effect of Cablevision on U.S. VC Investment	118.7576*	126.1020**
	(59.1897)	*(51.2073)*
Percent Change in GDP		20.6408**
		(9.2082)
Broadband Penetration Rate		707.0396*
		(372.2410)
Constant	-37.6883	-170.0521**
	(22.7698)	*(71.2992)*
Observations	40	40
Adjusted R-Squared	0.783	0.838
Implied Increase in U.S. Cloud VC Investment ($ Millions)	**$1,191**	**$1,268**
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 7

Cloud Computing Regression Results: U.S. vs. EU[1,2,3]

Dependent Variable: Whether a Deal is a Cloud Deal (0/1)

Data are Restricted to Investments by VC firms Which Have Done at Least One Cloud Deal Previously

	Model				
	(11)	(12)	(13)	(14)	(15)
U.S. Indicator	-0.054***	0.013***	0.013***	-0.127	-0.127
	(0.000)	*(0.003)*	*(0.003)*	*(0.101)*	*(0.101)*
2008 Dummy[4]	-0.884***	-1.584***	17.742***	-1.772***	6.345***
	(0.000)	*(0.001)*	*(4.249)*	*(0.295)*	*(1.561)*
Effect of Cablevision on U.S. VC Investment	1.220***	1.217***	1.214***	1.475***	1.475***
	(0.000)	*(0.012)*	*(0.012)*	*(0.310)*	*(0.310)*
Percent Change in GDP			7.819***		3.593***
			(1.612)		*(0.475)*
Broadband Penetration Rate			78.141***		83.760***
			(6.404)		*(1.108)*
Constant	-2.345***	-1.278***	-46.826***	17.045***	-16.397***
	(0.000)	*(0.069)*	*(5.335)*	*(1.214)*	*(2.167)*
Quarter of Year Fixed Effects?	No	Yes	Yes	Yes	Yes
VC Firm Fixed Effects	No	No	No	Yes	Yes
Observations	5,539	5,539	5,539	4,512	4,512
Pseudo R-Squared	0.00670	0.0212	0.0212	0.156	0.156
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:

[1] A logit model was used. If a deal is a cloud deal the binary dependent variable is equal to one; otherwise, it is equal to zero.

[2] Clustered standard errors (by region) are provided under the point estimates in italics.

[3] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.

[4] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 8
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: Number of Rounds of VC Investment

	Model	
Independent Variables	(16)	(17)
U.S. Indicator	15.5***	13.4***
	(1.9)	*(1.5)*
2008 Dummy[3]	0.8	-3.7
	(0.8)	*(2.4)*
Effect of Cablevision on U.S. VC Investment	6.5*	6.6**
	(3.8)	*(2.9)*
Percent Change in GDP		2.2**
		(1.0)
Broadband Penetration Rate		102.7***
		(33.9)
Constant	1.2***	-19.0***
	(0.3)	*(6.4)*
Observations	40	40
Adjusted R-Squared	0.787	0.845
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 9
Cloud Computing Regression Results: U.S. vs. EU[1,2]
Dependent Variable: For Each of IaaS, PaaS, and SaaS, Ratio of Cloud Computing VC Dollars to Total IT VC Dollars

	Model		
	IaaS	PaaS	SaaS
Independent Variables	(18)	(19)	(20)
U.S. Indicator	0.0026	0.0057***	0.0151***
	(0.0034)	*(0.0013)*	*(0.0037)*
2008 Dummy[3]	-0.0016	0.0000	0.0081
	(0.0028)	*(0.0005)*	*(0.0073)*
Effect of Cablevision on U.S. VC Investment	0.0117**	0.0061**	0.0089
	(0.0050)	*(0.0030)*	*(0.0087)*
Constant	0.0039	0.0003	0.0074
	(0.0026)	*(0.0003)*	*(0.0026)*
Observations	40	40	40
Adjusted R-Squared	0.389	0.546	0.448
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:
[1] Robust standard errors (by quarter) are provided under the point estimates in italics.
[2] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.
[3] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

Table 10

Cloud Computing Regression Results: 2nd Circuit Court vs. Rest of U.S.[1,2,3,4,5]
Dependent Variable: Whether a Deal is a Cloud Deal (0/1)

	Model		
Independent Variables	(21)	(22)	(23)
2nd Circuit Indicator	-1.148***	-1.205***	-1.200***
	(0.181)	(0.179)	(0.179)
2008 Dummy[4]	0.626***	-0.228	1.029*
	(0.079)	*(0.206)*	*(0.569)*
Effect of Cablevision on 2nd Circuit VC Investment	0.704***	0.708***	0.716***
	(0.084)	*(0.087)*	*(0.086)*
Percent Change in GDP			0.418**
			(0.180)
Broadband Penetration Rate			1.861
			(6.720)
Constant	-3.430***	-2.031***	-4.363***
	(0.132)	*(0.202)*	*(1.313)*
Quarter of Year Fixed Effects?	No	Yes	Yes
Observations	29,356	29,356	29,356
Pseudo R-Squared	0.0143	0.0277	0.0251
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010

Notes:

[1] A logit model was used. If a deal is a cloud deal the binary dependent variable is equal to one; otherwise, it is equal to zero.

[2] Clustered standard errors (by state) are provided under the point estimates in italics.

[3] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level.

[4] Decision by Appellate Court (judgment of District Court is reversed) (8/4/2008). The 2008 Dummy variable is set equal to one for all quarters after 2Q 2008.

[5] 2nd Circuit Court's jurisdiction covers the states of New York, Connecticut, and Vermont.

Table 11
Cloud Computing Regression Results: France and Germany vs. the EU
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars[1]

	Model					
Independent Variables	(24)	(25)	(26)	(27)	(28)	(29)
France Indicator	-0.0125***	-0.0207***				
	(0.0041)	*(0.0060)*				
Q1 2009 Dummy[2]	0.0223**	0.0175*				
	(0.0092)	*(0.0091)*				
Effect of the Wizzgo Decision on French VC Investment	-0.0185*	-0.0176*				
	(0.0095)	*(0.0089)*				
Germany Indicator			-0.0031*	-0.0026	-0.0031*	-0.0029
			(0.0018)	*(0.0020)*	*(0.0017)*	*(0.0028)*
Q3 2006 Dummy[3]			0.0115**	0.0103*	0.0205***	0.0098
			(0.0049)	*(0.0053)*	*(0.0053)*	*(0.0094)*
Effect of German Decisions on German VC Investment			-0.0115**	-0.0133**	-0.0156**	-0.0233***
			(0.0049)	*(0.0054)*	*(0.0073)*	*(0.0065)*
Percent Change in GDP		0.0042**		0.0020		0.0025
		(0.0020)		*(0.0017)*		*(0.0016)*
Broadband Penetration Rate		0.1406**		0.0270		0.1181
		(0.0641)		*(0.0317)*		*(0.0821)*
Constant	0.0125***	-0.0137	0.0031*	-0.0010	0.0031*	-0.0102
	(0.0041)	*(0.0112)*	*(0.0018)*	*(0.0042)*	*(0.0017)*	*(0.0089)*
Observations	40	40	40	40	56	56
R-Squared	0.500	0.535	0.396	0.418	0.256	0.311
Implied Quarterly Decrease in Cloud VC Investment ($ Millions)	-2.0	-1.9	-0.5	-0.5	-0.6	-0.9
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2004 - 4Q 2008	1Q 2004 - 4Q 2008	1Q 2004 - 4Q 2010	1Q 2004 - 4Q 2010

Notes:
[1] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level. Robust standard errors are provided under the point estimates in italics.

[2] Decision by Tribunal de Grande Instance of Paris in November of 2008. The 2009 Dummy variable is set equal to one for all quarters after 4Q 2008.

[3] Decision by the German District Court against Shift.tv on May 12, 2006. The 2006 Dummy variable is set equal to one for all quarters after 2Q 2006. Additional decisions include an Appeals Court ruling against Shift.tv on November 28, 2006, a District Court ruling against Save.tv on May 9, 2007, an Appeals Court ruling in favor of Save.tv on October 9, 2007, and a Federal Court decision in which the cases against Shift.tv and Save.tv were remanded back to the Appeals Court on April 22, 2009.

Table 12
Cloud Computing Regression Results: France and Germany vs. ROW
Dependent Variable: Ratio of Cloud Computing VC Dollars to Total IT VC Dollars[1]

	Model		
Independent Variables	(30)	(31)	(32)
France Indicator	-0.0057*		
	(0.0028)		
Q1 2009 Dummy[2]	0.0117***		
	(0.0037)		
Effect of the Wizzgo Decision on French VC Investment	-0.0079*		
	(0.0045)		
Germany Indicator		-0.0012	-0.0012
		(0.0008)	*(0.0008)*
Q3 2006 Dummy[3]		0.0056*	0.0104***
		(0.0033)	*(0.0026)*
Effect of German Decisions on German VC Investment		-0.0056*	-0.0054
		(0.0033)	*(0.0056)*
Constant	0.0057*	0.0012	0.0012
	(0.0028)	*(0.0008)*	*(0.0008)*
Observations	40	40	56
R-Squared	0.467	0.239	0.111
Implied Quarterly Decrease in French Cloud VC Investment ($ Millions)	-0.9		
Implied Quarterly Decrease in German Cloud VC Investment ($ Millions)		-0.2	-0.2
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2004 - 4Q 2008	1Q 2006 - 4Q 2010

Notes:

[1] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level. Robust standard errors are provided under the point estimates in italics.
[2] Decision by Tribunal de Grande Instance of Paris in November of 2008. The 2009 Dummy variable is set equal to one for all quarters after 4Q 2008.
[3] Decision by the German District Court against Shift.tv on May 12, 2006. The 2006 Dummy variable is set equal to one for all quarters after 2Q 2006. Additional decisions include an Appeals Court ruling against Shift.tv on November 28, 2006, a District Court ruling against Save.tv on May 9, 2007, an Appeals Court ruling in favor of Save.tv on October 9, 2007, and a Federal Court decision in which the cases against Shift.tv and Save.tv were remanded back to the Appeals Court on April 22, 2009.

Table 13
Cloud Computing Regression Results: France and Germany vs. the EU
Dependent Variable: Cloud Computing VC Dollars[1]

	Model					
Independent Variables	(33)	(34)	(35)	(36)	(37)	(38)
French IT Minus Cloud VC Investment	0.0203*** *(0.0067)*	0.0195*** *(0.0062)*	0.0119 *(0.0079)*	-0.0129* *(0.0069)*	0.0144* *(0.0078)*	0.0144* *(0.0073)*
Total French VC Investment Minus IT Minus Cloud VC Investment	0.0002 *(0.0010)*	-0.0007 *(0.0010)*	-0.0005 *(0.0027)*	-0.0020 *(0.0023)*	-0.0022 *(0.0036)*	-0.0033 *(0.0032)*
France Indicator	1.6962 *(3.2316)*	-3.0309 *(4.1813)*				
Q1 2009 Dummy[2]	10.3236** *(3.8434)*	8.0265** *(3.9036)*				
Effect of the Wizzgo Decision on French VC Investment	-9.9446** *(3.8490)*	-8.1107** *(3.4266)*				
Germany Indicator			1.8987 *(2.4262)*	1.9702 *(2.3332)*	1.8041 *(1.8319)*	1.6259 *(1.9181)*
Q3 2006 Dummy[3]			3.7146 *(2.5231)*	3.9986 *(2.4620)*	7.5471*** *(2.3380)*	6.7182** *(2.6475)*
Effect of German Decisions on German VC Investment			-3.7622 *(2.5160)*	-4.9726* *(2.8590)*	-7.2437*** *(2.3567)*	-9.0964*** *(2.7749)*
Percent Change in GDP		2.7005** *(1.0572)*		1.5993 *(1.0032)*		1.4356 *(0.8902)*
Broadband Penetration Rate		63.7616** *(31.1572)*		9.6318 *(16.3778)*		18.5790 *(12.9991)*
Constant	-3.8858 *(3.8896)*	-14.9104*** *(5.1048)*	-2.3038 *(2.7809)*	-3.9396 *(2.4841)*	-2.1293 *(2.0958)*	-4.3394** *(1.8465)*
Observations	40	40	40	40	56	56
R-Squared	0.571	0.628	0.448	0.495	0.472	0.513
Implied Quarterly Decrease in French Cloud VC Investment ($ Millions)	-9.9	-8.1	-3.8	-5.0	-7.2	-9.1
Length of Time Period	1Q 2006 - 4Q 2010	1Q 2006 - 4Q 2010	1Q 2004 - 4Q 2008	1Q 2004 - 4Q 2008	1Q 2004 - 4Q 2010	1Q 2004 - 4Q 2010

Notes:

[1] *** indicates significance at a 1 percent level, ** indicates significance at a 5 percent level, and * indicates significance at a 10 percent level. Robust standard errors are provided under the point estimates in italics.

[2] Decision by Tribunal de Grande Instance of Paris in November of 2008. The 2009 Dummy variable is set equal to one for all quarters after 4Q 2008.
[3] Decision by the German District Court against Shift.tv on May 12, 2006. The 2006 Dummy variable is set equal to one for all quarters after 2Q 2006. Additional decisions include an Appeals Court ruling against Shift.tv on November 28, 2006, a District Court ruling against Save.tv on May 9, 2007, an Appeals Court ruling in favor of Save.tv on October 9, 2007, and a Federal Court decision in which the cases against Shift.tv and Save.tv were remanded back to the Appeals Court on April 22, 2009.

Appendix A - *Cablevision* Decision
Summary Statistics for Investment Levels and Regression Variables

	Q1 1995 - Q4 2010						Pre Cablevision: Q1 2006 - Q2 2008						Post Cablevision: Q3 2008 - Q4 2010					
	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total
VC Investment in U.S. Cloud ($ Millions)[1]	$92.3	$88.0	$0.0	$71.8	$406.5	$5,906.3	$131.0	$39.9	$72.9	$125.8	$191.1	$1,309.7	$184.7	$84.9	$58.8	$176.6	$369.4	$1,847.1
VC Investment in U.S. Cloud as % of VC Investment in U.S. IT[1]	2.2%	2.3%	0.0%	1.6%	11.5%		3.2%	0.9%	1.8%	3.0%	4.6%		6.3%	2.4%	3.1%	6.1%	11.5%	
VC Investment in EU Cloud ($ Millions)[1]	$3.8	$7.4	$0.0	$0.0	$34.0	$242.3	$7.0	$7.7	$0.0	$4.5	$20.5	$69.9	$8.9	$11.5	$0.0	$3.7	$34.0	$88.7
VC Investment in EU Cloud as % of VC Investment in E.U. IT[1]	0.7%	1.4%	0.0%	0.0%	6.4%		1.2%	1.2%	0.0%	0.9%	3.6%		1.8%	2.2%	0.0%	0.8%	6.4%	
Real U.S. GDP Growth Rate Prior Quarter[2]	0.6%	0.7%	-2.3%	0.7%	2.0%		0.4%	0.5%	-0.4%	0.4%	1.3%		-0.1%	1.2%	-2.3%	0.5%	1.0%	
Real EU GDP Growth Rate Prior Quarter[2]	0.5%	0.6%	-2.6%	0.5%	1.2%		0.7%	0.4%	-0.3%	0.7%	1.0%		-0.3%	1.1%	-2.6%	0.3%	1.0%	
U.S. Broadband Penetration Rate[3]	17.7%	7.4%	5.4%	18.6%	27.7%		20.7%	2.6%	16.6%	20.8%	23.9%		26.1%	0.8%	24.7%	25.9%	27.7%	
EU Broadband Penetration Rate[3]	15.0%	8.4%	2.0%	15.8%	26.0%		18.2%	3.0%	13.5%	18.5%	22.2%		24.6%	1.0%	22.8%	24.9%	26.0%	

Notes and Sources:
[1] Thomson ONE Private Equity data, Jan 1995 to Dec 2010.
[2] OECD real GDP growth from the previous quarter.
[3] OECD broadband penetration rate.

Appendix B - French Ruling
Summary Statistics for Investment Levels and Regression Variables

	Q1 1995 - Q4 2010						Pre-Wizzgo Decision: Q1 2006 - Q4 2008						Post-Wizzgo Decision:: Q1 2009 - Q4 2010					
	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total
VC Investment in French Cloud ($ Millions)[1]	$0.056	$0.321	$0.000	$0.000	$2.199	$3.561	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.445	$0.854	$0.000	$0.000	$2.199	$3.561
VC Investment in French Cloud as % of VC Investment in French IT[1]	0.05%	0.28%	0.00%	0.00%	1.70%		0.00%	0.00%	0.00%	0.00%	0.00%		0.38%	0.72%	0.00%	0.00%	1.70%	
VC Investment in EU Cloud ($ Millions)[1]	$3.645	$7.301	$0.000	$0.000	$32.645	$233.303	$5.900	$7.388	$0.000	$3.070	$20.500	$70.800	$9.840	$12.037	$0.000	$3.707	$32.645	$78.720
VC Investment in EU Cloud as % of VC Investment in E.U. IT[1]	0.91%	1.88%	0.00%	0.00%	8.79%		1.25%	1.41%	0.00%	0.65%	3.83%		2.76%	2.87%	0.00%	1.97%	8.13%	
Real French GDP Growth Rate Prior Quarter[2]	0.41%	0.51%	-1.58%	0.53%	1.31%		0.19%	0.69%	-1.45%	0.37%	1.07%		0.10%	0.71%	-1.58%	0.34%	0.60%	
Real EU GDP Growth Rate Prior Quarter[2]	0.53%	0.61%	-2.33%	0.62%	1.34%		0.31%	0.90%	-1.84%	0.69%	1.04%		-0.03%	1.00%	-2.33%	0.30%	0.75%	
French Broadband Penetration Rate[3]	18.01%	10.44%	1.57%	18.84%	33.66%		22.54%	3.75%	16.31%	22.95%	27.64%		30.95%	1.91%	28.30%	30.92%	33.66%	
EU Broadband Penetration Rate[3]	13.61%	7.31%	1.78%	14.97%	22.62%		17.75%	2.83%	12.88%	18.14%	21.41%		21.57%	0.87%	20.15%	21.60%	22.62%	

Notes and Sources:
[1] Thomson ONE Private Equity data, Jan 1995 to Dec 2010.
[2] OECD real GDP grwoth from the previous quarter
[3] OECD broadband penetration rate.

Appendix C - German Ruling
Summary Statistics for Investment Levels and Regression Variables

	Q1 1995 - Q4 2010						Pre-German District Court decision: Q1 2004 - Q2 2006						Post-German District Court decision: Q3 2006 - Q4 2008						Post-German District Court decision: Q3 2006 - Q4 2010					
	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total	Mean	Std Dev	Min	Med	Max	Total
VC Investment in German Cloud ($ Millions)[1]	$0.087	$0.690	$0.000	$0.000	$5.473	$5.473	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.000	$0.304	$1.290	$0.000	$0.000	$5.473	$5.473
VC Investment in German Cloud as % of VC Investment in German IT[1]	0.15%	1.15%	0.00%	0.00%	8.86%		0.00%	0.00%	0.00%	0.00%	0.00%		0.00%	0.00%	0.00%	0.00%	0.00%		0.49%	2.09%	0.00%	0.00%	8.86%	
VC Investment in EU Cloud ($ Millions)[1]	$3.645	$7.301	$0.000	$0.000	$32.645	$233.303	$3.514	$7.094	$0.000	$0.000	$22.710	$35.140	$6.913	$7.728	$0.000	$4.545	$20.500	$69.126	$8.214	$9.671	$0.000	$4.483	$32.645	$147.846
VC Investment in EU Cloud as % of VC Investment in E.U. IT[1]	0.91%	1.88%	0.00%	0.00%	8.79%		1.18%	2.73%	0.00%	0.00%	8.79%		1.46%	1.46%	0.00%	1.30%	3.83%		2.04%	2.23%	0.00%	1.59%	8.13%	
Real German GDP Growth Rate Prior Quarter[2]	0.32%	0.88%	-4.01%	0.36%	1.95%		0.44%	0.57%	-0.15%	0.29%	1.51%		0.27%	1.03%	-2.17%	0.62%	1.22%		0.24%	1.36%	-4.01%	0.62%	1.95%	
Real EU GDP Growth Rate Prior Quarter[2]	0.53%	0.61%	-2.33%	0.62%	1.34%		0.71%	0.23%	0.36%	0.75%	0.99%		0.19%	0.94%	-1.84%	0.64%	1.04%		0.09%	0.94%	-2.33%	0.41%	1.04%	
German Broadband Penetration Rate[3]	17.21%	10.31%	3.14%	16.55%	31.93%		10.10%	3.16%	6.01%	9.71%	15.01%		22.72%	3.81%	16.55%	23.07%	27.44%		26.17%	4.91%	16.55%	27.16%	31.93%	
EU Broadband Penetration Rate[3]	13.61%	7.31%	1.78%	14.97%	22.62%		9.54%	2.83%	5.52%	9.40%	13.97%		18.61%	2.18%	14.97%	19.00%	21.41%		19.93%	2.26%	14.97%	20.54%	22.62%	

Notes and Sources:
[1] Thomson ONE Private Equity data, Jan 1995 to Dec 2010.
[2] OECD real GDP grwoth from the previous quarter
[3] OECD broadband penetration rate.